ZETEX

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Soldering Surface Mount Devices

Whilst Surface Mount Devices (SMD) offer many important advantages, it should be recognised by potential users that there is a technological change required in moving from through-hole (leaded component) to surface mount assembly.

Unlike leaded components, which are mechanically supported by insertion of the leads through the board, SMDs rely on the solder joints alone to provide both the mechanical support and the electrical connection.

If the board is to be inverted for wave soldering then the devices are usually secured by an (epoxy) adhesive prior to the actual soldering operation. In the case of reflow soldering, where the devices remain uppermost, then they are usually held in place by solder paste which has been screen-printed onto the PCB prior to placement.

Processing: general

High Temperature Exposure:
SMDs, having shorter leads and being mounted on the side of the PCB exposed directly to the heat source, are at a much higher risk of damage from thermal shock. Care should therefore be taken to minimise both the thermal gradients and the maximum solder temperature. Low profile, high pin count, fine pitch devices are at greatest risk and their presence on the board will ultimately dictate the soldering parameters.

Soldering Conditions:
Not only will this depend on the component mix (as mentioned above), but also on board size and total thermal mass. For users who assemble a variety of different boards, it may be necessary to tailor the solder profiles for those boards which exhibit significant variations in the soldering characteristics. Fine pitch devices are normally restricted to reflow soldering processes where the solder is applied to the boards prior to device placement and then the whole board assembly is heated above the melting point of the solder.

Fluxes:
Highly active fluxes are not recommended and should not be required provided that the devices have not been exposed to any extreme storage conditions. Strongly acidic fluxes of the type associated with aqueous cleaning systems, should be treated with caution as they have been linked to device corrosion. Standard board cleaning techniques should not

present device problems provided that the boards are properly dried to remove solvents or water residues.

Reflow Soldering

1. Ramp-up:
During this stage the solvents are evaporated from the solder paste. Care should be taken to prevent rapid oxidation (or paste slump) and the subsequent possibility of solder bursts through aggressive solvent outgassing.

A typical heating rate is 2°C/sec.

2. Pre-heat / soak:
A constant temperature zone which performs the dual role of activating the flux whilst achieving a uniform board temperature. The objective is to ensure even wetting characteristics across all the devices on the board.

Typical soak conditions are: 30-150 secs at 150-170°C.

3. Reflow zone:
Maximum soldering temperatures will be determined by the most temperature sensitive devices on the PCB, which will typically be the large area, high pin count packages. If the temperature is too high then the devices may be damaged by mechanical stressing due to thermal mis-match or there may be problems due to excessive solder oxidation. Too low a temperature may mean that some of the devices fail to achieve the minimum soldering conditions. However, caution should be taken in extending the dwell time to compensate, as excessive time at temperature can enhance the formation of intermetallic compounds at the lead / board interface and may lead to early mechanical failure of the joint. High density circuits may require finer tuning of the profile because of their higher thermal mass.

Maximum soldering temperatures for most boards will be in the range 215-220°C, with a limit of 235°C.

4. Cooling:
Again, there is a compromise to be achieved: steep thermal gradients may give rise to excessive thermal shock, but fast cooling will promote a finer grain structure and a more crack resistant joint.

Figure 1 indicates the recommended soldering profile.

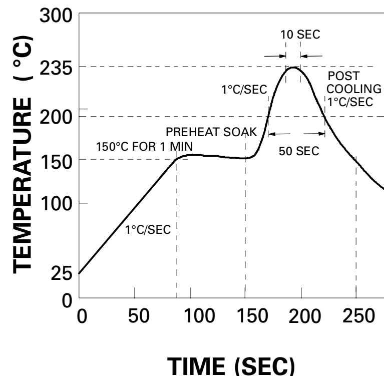

Figure 1
Reflow Soldering Profile.

Numerical values, along with suggested operating ranges are summarised in Table 1.

Heating rate during pre-heat	Typical 1-2, max 4°C / sec
Pre-heat temperature	Typical 150, max 170°C
Pre-heat dwell time	Typical 60, max 180 sec
Liquidus time above 200°C	30-90 sec

Table 1
Reflow Soldering Parameters.

Wave (Flow) Soldering

In this process it is normal for the SMDs to be secured to the board by an epoxy-based adhesive prior to soldering. Too much adhesive may encroach upon the pads or component leads, whereas too little may not be sufficient to prevent the component moving before the adhesive has cured.

The solder pad must extend beyond the end of the component (lead) and be large enough to pick up sufficient solder from the wave to make a satisfactory joint.

Care should be taken to prevent shadowing by other components and also to avoid bridging of leads. For this reason, wave soldering is not normally the preferred method for fine pitch devices. It is more usually employed as one of the two (or more) soldering operations which take place during the assembly of mixed technology boards.

Figure 2 indicates the recommended soldering profile.

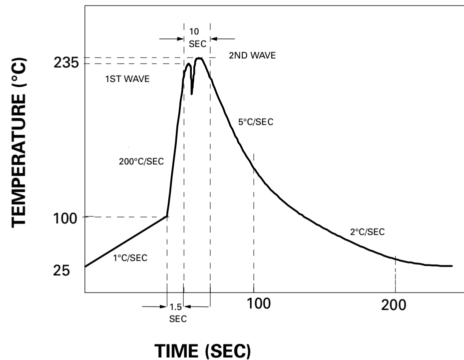

Figure 2
Wave Soldering Profile.

Numerical values, along with suggested operating ranges are summarised in Table 2

Heating rate during pre-heat	Typical 1-2, max 4°C / sec
Final pre-heat temperature	Within 125°C of solder temp
Solder temperature	Max 235°C*
Cooling rate	Max 5°C / sec

*Maximum time of 10 seconds for double wave.

Table 2
Wave (Flow) Soldering Parameters.